AquaPark – Norad funded project

Planning and management of aquaculture parks for sustainable development of cage farms in the Philippines

www.aqua-park.asia
Mariculture park management

- Mooring trial
- Oil spill contingency planning
- Better Management practices
- Socio economic survey
- Economic analysis
- Layout optimisation
- Integrated Aquaculture

AquaPark Mid-term meeting - interim results
Mooring Trial
Typical cage mooring
Mooring trial - scale model

Mooring Scale Model
Mooring trial - scale model
Mooring trial - scale model

Measure kilos of pull needed to move the moorings

Mud on bottom of tank
Improved Mooring System

Independent block moorings, upward lift
Improved Mooring System

Independent block moorings, sideways lift
Improved Mooring System

Interlinked block moorings, upward lift
Scale Model Set-up
Mooring Scale Model
Mooring Scale Model
Improved moorings
Results – oil spill contingency

This working report attempts to summarise the measures that Mariculture parks can take to be prepared to deal with oil spills.

The reports summarises
- Biological impacts of spills on fish, shellfish and sensitive environments
- Oil spill contingency planning and response
- Cleanup
- Compensation.
Results – Better Management Practices

Draft BMPs which follow the culture process as follows

Crosscutting issues
1. Planning and siting
2. Farm design and construction
3. Fry and Fingerling purchase or collection
4. Nursery production
5. Production management
6. Fish health
7. Fish quality and food safety
8. Harvest and post harvest management
9. Monitoring and record keeping
10. Social (staff training, health and safety)
11. Environmental management

AquaPark Mid-term meeting - interim results
Socio-economic survey

Undertook socio-economic analysis (positive & negative) either perceived or verifiable impacts of implementing Mariculture Parks for

– farmer-beneficiaries,
– Upstream and downstream stakeholders and
– Local communities and LGUs.
SOCIOECONOMIC FRAMEWORK - ADVANTAGES & BENEFITS

UPSTREAM OPPORTUNITIES /ACTIVITIES:
• Feeds Suppliers; Fry / Fingerlings Suppliers
• Development of Fish Hatcheries/Fish Nurseries
• Sellers/Suppliers of Bamboos, Nets, Ropes, Twines, boat makers
• Create employment (support staff)

MARICULTURE PARK

DOWNSTREAM OPPORTUNITIES/ACTIVITIES:
• Fish Traders, Fish Vendors
• Fish Processors; Ice Sellers
• Transport rentals
• Marketing channels and locations

EFFECTS / DIRECT BENEFITS:
• Create employment opportunities to local communities; Livelihoods
• Incremental change of income for marginal fishing families – as caretakers, harvesters, cage makers, feeders, cage repairers, security guards, net washers, etc.

PERIPHERAL EFFECTS / INDIRECT BENEFITS:
• Establishments of General Merchandise (sari-sari) Stores; Bakeshops
• Establishments of coffee shops, restaurants, etc.

ADDITIONAL REVENUE TO LGUs (permitting, licensing system)
Economic survey

- Investigate the economics and economic benefits of mariculture parks for the different types of locators and for the local Government/BFAR MP development, technical and infrastructure support in case study areas.

- Assess and compare the economic influence of MPs in the case study locations and the comparative regional differences for input costs and market prices.
Economic survey

The key components of this investigation are to assess the economics of:

- Different aquacultural farming systems in the MPs;
- LGU and BFAR support for setting up and providing support of the MP
- Differences in regional input cost comparisons,
- Cost/benefit and breakeven analysis for support infrastructure
- Local and regional market analysis comparisons.
LOCAL GOVERNMENT UNITS

1. Investment on infrastructure (e.g. roads, markets, etc.,
2. Investment on services
3. Power supply, etc.

GOVERNMENT AGENCIES
BFAR, DAR, DENR, etc.)

1. Technical services
2. Legal services
3. Manpower development

PRIVATE SECTOR

1. Feed companies
2. Fish seed production
3. Laboratory services (fish disease lab, analytical lab, etc.)

*How can these infrastructures and services improve the life of the stakeholders? Are these investments economically viable?
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Less than 10 Cages</th>
<th>10-20 cages</th>
<th>More than 20 Cages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Fixed Expenses (% of sales)</td>
<td>24%</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>Average Variable Expenses (% of sales)</td>
<td>50%</td>
<td>26%</td>
<td>29%</td>
</tr>
<tr>
<td>Average Other Operating Expenses (% sales)</td>
<td>6%</td>
<td>14%</td>
<td>5%</td>
</tr>
<tr>
<td>Recovery from Depreciation</td>
<td>(4%)</td>
<td>(3%)</td>
<td>(2%)</td>
</tr>
<tr>
<td>Average Net Profit (% of sales)</td>
<td>24%</td>
<td>46%</td>
<td>51%</td>
</tr>
<tr>
<td>Average Net Profit Per cage (Php)</td>
<td>185,741</td>
<td>230,507</td>
<td>287,776</td>
</tr>
<tr>
<td>Average Return on Investment</td>
<td>72%</td>
<td>117%</td>
<td>112%</td>
</tr>
</tbody>
</table>
Mariculture park optimisation

- Started work on trying to optimise Sual production
- Chris Cromey presentation
TROPOMOD cage layouts

Scenario A3 – existing cage layout

Scenario B2 – AquaPark scenario
Three 10 ha areas
40 cages per 10 ha
100 m space in middle of blocks to allow flushing

Scenario B1 – AquaPark scenario
Three 10 ha areas
100 cages per 10 ha
No space in the middle of the zone

Scenario B3 – AquaPark scenario
Three 10 ha areas
56 cages per 10 ha
100 m space in middle of blocks to allow flushing
Scenario A3 – existing situation at Sual

Scenario B1 – AquaPark – three 10 Ha areas with 100 cages (11 rows by 9 columns) in each

Impact is very severe under cages and predicted to be worse than existing situation
To attempt to improve on the severe predicted impact in scenario B1, we maintain the 30 ha areas and reduce the numbers of cages in each area.

<table>
<thead>
<tr>
<th>Existing area to the SE</th>
<th>Proposed</th>
<th>Proposed</th>
<th>Proposed (with careful feeding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>26.7 hectares</td>
<td>30 ha</td>
<td>30 ha</td>
</tr>
<tr>
<td>Number of cages</td>
<td>122</td>
<td>300</td>
<td>120</td>
</tr>
<tr>
<td>Area per cage</td>
<td>2188 m²</td>
<td>1000 m²</td>
<td>2500 m²</td>
</tr>
<tr>
<td>TROPOMOD scenario</td>
<td>A3</td>
<td>B1</td>
<td>B2</td>
</tr>
</tbody>
</table>
Scenario A3 – existing situation at Sual

Scenario B2 – AquaPark – three 10 Ha areas with 40 cages each (2 blocks of 20 cages)

Predicted impact is much improved, with lanes between the blocks of cages where predicted impact is lower.

Flux (g m\(^{-2}\) d\(^{-1}\))

- Benthic Community
  - Severe impact (no animals)
    - 150
  - High impact
    - 75
  - Moderate impact
    - 15
  - Scale (m)
    - 0, 200, 400, 600, 800
To attempt to improve on the predicted impact in scenario B1, we examine the husbandry practices.

In the model, we waste less feed, use a higher quality feed with better digestibility. This means we can also feed less.

As husbandry practices are better, we can increase the number of cages in the three 10 ha areas from 40 per area to 56 cages.

<table>
<thead>
<tr>
<th></th>
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<th>Proposed (with careful feeding)</th>
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</thead>
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<tr>
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<td>122</td>
<td>300</td>
<td>120</td>
<td>168</td>
</tr>
<tr>
<td>Area per cage</td>
<td>2188 m²</td>
<td>1000 m²</td>
<td>2500 m²</td>
<td>1786 m²</td>
</tr>
<tr>
<td>TROPOMOD scenario</td>
<td>A3</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
</tr>
</tbody>
</table>
TROPOMOD model input data – scenarios of husbandry practices

Husbandry data obtained from production surveys at Sual used in the scenarios.

<table>
<thead>
<tr>
<th>Model input data</th>
<th>Scenario B2</th>
<th>Scenario B3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor feeding</td>
<td>Careful feeding</td>
</tr>
<tr>
<td></td>
<td>Low digest.</td>
<td>Better digestibility</td>
</tr>
<tr>
<td>Feed wasted</td>
<td>27%</td>
<td>10%</td>
</tr>
<tr>
<td>Feed digestibility</td>
<td>49%</td>
<td>56%</td>
</tr>
<tr>
<td>Empty Starter</td>
<td>Feed input</td>
<td>Feed input</td>
</tr>
<tr>
<td></td>
<td>0 kg/cage/d (5 % cages)</td>
<td>0 kg/cage/d (5 % cages)</td>
</tr>
<tr>
<td></td>
<td>159 kg/cage/d (23 % cages)</td>
<td>114 kg/cage/d (23 % cages)</td>
</tr>
<tr>
<td></td>
<td>337 kg/cage/d (23 % cages)</td>
<td>241 kg/cage/d (23 % cages)</td>
</tr>
<tr>
<td></td>
<td>526 kg/cage/d (49 % cages)</td>
<td>376 kg/cage/d (49 % cages)</td>
</tr>
</tbody>
</table>

All cages – circular 20 m diameter by 12 m depth with Milkfish
Scenario B2 – AquaPark – three 10 Ha areas with 40 cages each (2 blocks of 20 cages)

Scenario B3 – AquaPark – three 10 Ha areas with 56 cages each.

By improving husbandry, an additional 16 cages could be included per 10 ha
**TROPOMOD model – summary of scenarios**

<table>
<thead>
<tr>
<th></th>
<th>Scenario B1</th>
<th>Scenario B2</th>
<th>Scenario B3 (improved husbandry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of cages per 10 ha</td>
<td>100</td>
<td>40</td>
<td>56</td>
</tr>
<tr>
<td>Biomass per cage (tonnes)</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Biomass per 10 ha (tonnes)</td>
<td>3400</td>
<td>1360</td>
<td>1904</td>
</tr>
</tbody>
</table>

Average stocking density = 8.9 kg m$^{-3}$
Target FCR (wet weight) = 2.2
Specific Feeding Rate (SFR) = 1.6 (scenarios B1 and B2) and 1.2 (scenario B3)
Integration of IMTA

- Developing Integrated Multitrophic Aquaculture practice into Mariculture Parks
Concept for IMTA in Mariculture Parks
IMTA scenario 2 (Panabo) – wastes from cages reaching suspended culture

Further away from the cages (25 m), particles have settled out and do not reach the suspended culture.
IMTA scenario 2 (Panabo)
(view from above)

Percentage of waste feed and faeces reaching suspended culture

For Panabo, residual current to the south means predictions are higher at the IMTA units to the south, and lower to the east
### IMTA scenario 2 (Panabo) – wastes from cages reaching suspended culture at different depths

<table>
<thead>
<tr>
<th>Distance from cage edge (m)</th>
<th>% of waste feed and faeces intersecting suspended culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 m</td>
<td>1% 4% 11% 16% 13% 9% 5% 1%</td>
</tr>
<tr>
<td>20 m</td>
<td>2% 5% 8% 8% 7% 6% 6% 2%</td>
</tr>
<tr>
<td>15 m</td>
<td>2% 2% 3% 2% 2% 2% 2% 2%</td>
</tr>
<tr>
<td>10 m</td>
<td>1% 1% 2% 2% 1% 1% 1% 1%</td>
</tr>
<tr>
<td>5 m</td>
<td>1% 1% 1% 1% 1% 1% 1% 1%</td>
</tr>
</tbody>
</table>

- The majority of the wastes intersect the suspended culture in the top 6 m; these wastes are mostly fine and slow settling Milkfish faeces.

- Net depth is important when considering optimum depth of suspended culture.
IMTA scenario 3 (Panabo) – plume from cages reaching seaweed culture at different depths

% of plume intersecting seaweed culture to the EAST of the cages

<table>
<thead>
<tr>
<th>Distance from cage edge (m)</th>
<th>0-3m</th>
<th>3-6m</th>
<th>6-9m</th>
<th>9-12m</th>
<th>12-15m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0m</td>
<td>19%</td>
<td>2%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>3m</td>
<td>14%</td>
<td>2%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>5m</td>
<td>8%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>10m</td>
<td>3%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>25m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

The majority of the plume containing dissolved nutrients intersects the seaweed culture in the top 3 m.

Net depth is important when considering optimum depth of seaweed culture.
IMTA scenario 3 (Panabo) – plume from cages reaching seaweed culture at different depths

More of the plume intersects seaweed culture to the south of the cages as this is the direction of the residual current.

Net depth is important when considering optimum depth of seaweed culture.
IMTA scenario 3 (Panabo) – plume from a large polar circle cage reaching seaweed culture at different depths

% of plume intersecting seaweed culture to the SOUTH of the cages

<table>
<thead>
<tr>
<th>Distance from cage edge (m)</th>
<th>0-3m</th>
<th>3-6m</th>
<th>6-9m</th>
<th>9-12m</th>
<th>12-15m</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 m</td>
<td>6%</td>
<td>10%</td>
<td>11%</td>
<td>12%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>10 m</td>
<td>6%</td>
<td>10%</td>
<td>12%</td>
<td>12%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>5 m</td>
<td>5%</td>
<td>7%</td>
<td>9%</td>
<td>10%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>3 m</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>0 m</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

A deeper net means more of the suspended line comes into contact with the plume.

Seaweed culture at depth will be limited by light rather than nutrients.
IMTA scenario 1 – benthic structures

TROPOMOD predictions of the waste feed and faeces depositing on 8 m by 8 m structures on the sea bed

Structures for benthic culture
IMTA scenario 1 (Panabo) (view from above)
Benthic structures

For structures on the sea bed, around 20% of wastes deposited within 8 m of the cages

Fine, slow settling Milkfish faeces are dispersed away from these structures
Concept of cage within a cage production

cage within a cage

fed cage - groupers

unfed cage - miltfish/siganid

fed cage

unfed cage

heavy fecal material and pellets

light fecal material
IMTA 4 – cage in a cage

Grouper are in the inner cage, Milkfish in the outer cage
Clean outer nets are essential
Assumptions – all units are dry mass except the ration

Grouper: wasted feed – 12%, digestibility – 49 %, wet FCR 7.5
Milkfish: consumes 70 % of waste feed, 30 % of waste faeces